Preliminary Cost Estimating

by WILLIAM E. BLUROCK, FAIA

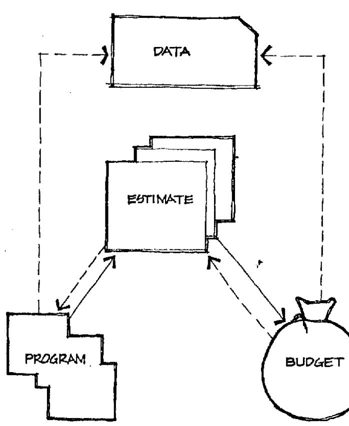


Figure 1

The size, quality and complexity of a project must be considered in preliminary cost estimating. These elements are reflected in a three-pronged, crosschecking system in which square footage and area of enclosure methods, joined by a percentage analysis, gives the architect a simple but effective tool early in the game.

Projecting a cost estimate in the early stages of a job is often like throwing darts at a "cost board." Frequently, the estimate is a "seat of the pants" guess, with too little backup to be truly valid. The efforts on the part of many architects to make an intelligent approach to proper cost estimating are further complicated by a multitude of pitfalls

Take the owner's budget. More than likely it was arrived at in a manner that had little or no bearing on the architectural solution. Sometimes the budget consists of monies which remain after all other items of budget have been satisfied. "That is all," says the client, "that I am able to spend." Perhaps his uncle is a contractor, or worse yet, a financial representative for a lending institution who knows that "it should not cost over $12 per square foot," regardless of the availability of utilities or of whether the proposed site is an old city dump.

With this line of reasoning, we could go on and on enumerating the obstacles and hypothetical budgets. The point is that the architect must develop methods by which cost estimates can be easily and efficiently made in the early stages of the program and the project cost budget checked before the job gets too far along. Early cost estimates are too often carried through to become the final, fixed budget — with the client becoming disenchanted, to say the least, with the architect and his services. The rectifying of this estimate to achieve a true "balance of program to budget" can make heroes of almost any architect and his staff.

What are we going to do to increase our expertise in projecting costs and reducing the gamble? First and foremost, a schematic estimate of construction cost must be made simple, direct and easy for everyone to arrive at—even the designer who claims immunity to the dirty word "cost." The designer with the project manager should evaluate and be made aware of the costs and the conditions under which these costs are valid. Therefore, what is proposed is not one system but three simple sets of rules which can crosscheck each other and be made available to work backward from budget to size of scope of project. This adds to rather than conflicts with Chapter 15, "Construction Cost Analysis," in *The Architect's Handbook.*

The accuracy of all good systems relies upon two factors: 1) a good data or historical base, whether your own or a composite from various services, magazine articles and other sources that are kind enough to supply similar data for comparison and 2) a consistent method of procedure that is *always the same* and will average out other irregularities. Every office, whether large or small, should keep a file and develop a system based upon its own needs with these two qualifications: data depth and, above all, a consistency of take-off that allows averaging of good preliminary cost estimates.

As a past member of the Production Office Procedures Committee of The American Institute of Architects, I should like to propose a simple and yet valuable cost estimating system. It can best be described by the chart outlined in Figure 1. This shows a system which allows the architect to take a budget and project it into a cost estimate or, the reverse, to take a program and project it into a cost estimate, basing its accuracy on consistency of the data base and of a three-pronged estimating procedure.

Figure 2 elaborates on this system in detail. I will attempt to explain how it works, what its restrictions are and what its importance is as a means of crosscheck in averaging for a proper answer to either budget or program.

First, the budget should contain all costs, whether construction or not, and should represent the total investment by the client. Figure 3, a Cost Analysis Summary Sheet, is typically in use in many offices and attempts a breakdown of the total budget. This sheet should allow for the expansion of construction cost to include utilities, off- and on-site development and any other unusual conditions, serving as a matter of record.

The keystone in setting the limitations of the program is the budget; at the same time, the program can be the control point in arriving at a logical budget. The program includes all of the client's requirements, the most important of which is the *size* of the whole and all the parts thereof. Next in importance is the *quality* of construction, followed by *complexity*, based upon the subdivision and sophistication of the spaces.

The program should be analyzed in several ways so that the cost estimate can be compared and related to the data history of record. We propose to make all our analyses in three ways: 1) by the floor area, using AIA Document D101, where all enclosed space is computed at full area and exterior covered walks and covered paved areas, etc., at one-half full area; 2) by the enclosure unit method, similar to that which John R. Diehl, AIA, describes in the article "Creative Cost Control" in the April 1967 AIA JOURNAL and also later in this article; and 3) by the percentage method wherein portions of the building are compared on a percentage ratio of the total cost.

The enclosure area is the sum total of all planes, either vertical or horizontal. (One square foot equals one unit of enclosure.) The surfaces measured are in two dimensions: length and height and/or width, zero thickness. Zero thickness means that you measure only *once* a wall, partition or floor/ceiling sandwich. Include all units of building enclosure, projected to a flat plane parallel to surface measured. Anticipate construction (such as vaults and casework) which do not appear on the preliminaries. Tabulate areas completely for each floor and recap on summary sheet. Make all area take-offs in square feet, according to AIA Document D101. Use linometer for easy take-off.

Floor: Measure from exterior wall face, including basements, vaults, pits, etc., as full square footage. Do *not* include stair wells (these appear under "Stairs"). Calculate ramps as projected on a level plane parallel to the floor.

Exterior Walls: Measure gross square footage top of footing to floor level to floor and floor to parapet. Do not deduc ings. Include all-glass walls.

Interior Partitions: Measure floor to floor, except in a which partitions extend to hung ceilings only (a special c half-height movable partitions. Do *not* include toilet pa but do include movable partitions.

Cabinets and Casework: Measure casework, kitchen ment and cabinets as second wall.

Columns and Piers: Measure one-half entire expos of all freestanding columns and of piers projecting more inches. Estimate if necessary.

Stairs: Measure 1) square foot area of treads and la 2) projected area of risers; 3) projected area of rail if su from stair.

Roof and/or Podium: Measure 1) gross area of ro jected to a plane level with the floor; 2) gross area of surface. Note if areas in this column are roof or podium.

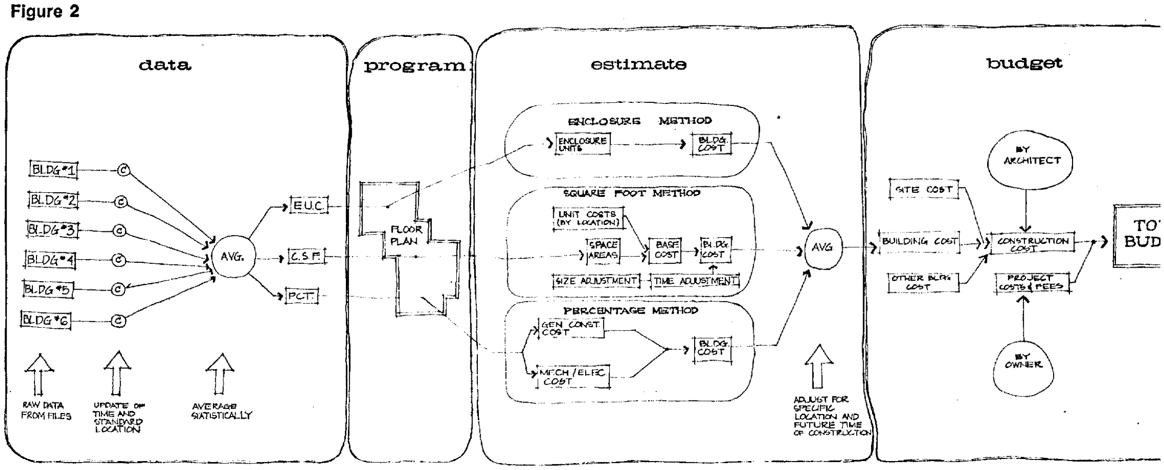
Other architects and members of the AIA Productior Procedures Commitee have supplied us with additional for the unit of enclosure method, including Frank Knobl senior associate of Deeter, Ritchey & Sippel of Pittsbur Joe Griffin, AIA, from the Caudill Rowlett Scott compute in Houston.

Data follows, or leads, the estimate like the chicken egg, depending on which way you are going: by way of co way of program. It represents a summary of various p and data information derived from past histories of projec comparison in a like manner of all these projects is ex important, whether they come from office files or fron sources; that is, apples must be compared with apples.

It must be remembered that in a preliminary cost the use of various types of quantity surveys is usually no As we review the data in Figure 3 under "Construction we move on to Figure 4 and not only expand its breakdo also exclude from it, for reasons of accurate calculation, th that do not affect the ratio of square footage, area of en or the percentage method of analysis, such as elevators, boxes and similar items that can be properly identified a costs in order to obtain a reasonable base for comparison of special cost to the project in question are then added t

In general, the square footage and area of enclosur ods have been described above; so the percentage me analysis should be elaborated upon. The percentage anal key to good balance, and a comparison of historical d

Figure 2



qualify this. Breaking out electrical, heating/ventilation and air-conditioning, plumbing, structural elements and everything else left (architectural) will give the architect a background not only for analyzing his portion of the work, which we agree at this stage is just barely under control, but also the work of the major consultants. The percentage ratio also carries with it automatic update that makes it most convenient; i.e., it can be directly applied to a total budget or program.

The estimate represents a variety of means by which the elements are related to fit a building to its budget or vice-versa. Following Figure 2, we may take the data base combined with

Figure 3

WILLIAM BLUROCK AND PARTNERS, ARCHITECTS

COST ANALYSIS SUMMARY SHEET — FL. AREA________
ENCL. AREA________
PRELIMINARY ( )
FINAL ( ) — ENCL. RATIO________
PROJECT:________ — DATE:________
OWNER:________

A. SITE ACQUISITIONS
1. PURCHASE PRICE $________
2. APPRAISALS $________
3. ESCROW COSTS $________
4. SURVEYS $________
5. ________ $________
6. TOTAL SITE ACQUISITION $________

B. CONSTRUCTION
1. UTILITY SERVICES $________
2. OFF-SITE DEVELOPMENT $________
3. ON-SITE DEVELOPMENT $________
4. RECONSTRUCTION $________
5. BUILDING CONSTRUCTION $________
6. ________ $________
7. TOTAL CONSTRUCTION $________

C. PLANS
1. ARCHITECT'S FEE $________
2. PLAN CHECK FEE $________
3. PRELIMINARY TESTS $________
4. OWNER'S LEGAL, ADMIN., INS. FEE AND ADVERT. $________
5. LANDSCAPE DESIGN FEE $________
6. INTERIOR DESIGN FEE $________
7. SPECIAL CONSULTANTS $________
8. ________ $________
9. TOTAL PLANS $________

D. CONSTRUCTION TESTING
E. INSPECTION $________
F. FURNITURE AND EQUIPMENT $________
G. CONTINGENCIES
____% OF CONSTRUCTION COST $ $________
H. TOTAL ESTIMATED COST (ITEMS A THRU G) $________

the program, update it with a factor for time, a typical location and the size of the job (small, medium or large) and follow the three methods of cost analysis. One does not have to follow all three, but it certainly gives a better average for arriving at a proper building cost. By adding the site work, unusual or other costs and valuing for an unusual site condition or updating for a future bid time, you have arrived at a competent total budget estimate.

In relating to the data base, the estimate cannot be over-emphasized as to its consistency and depth. Many offices, including our own, have made attempts at putting this information in computer storage for quick access and for averaging. This is only a convenience; a small card file, properly organized, could hold and retrieve easily any and all data.

The computer, as you can see from the following example, does have an advantage in that almost instantaneous updating and adjustment by any factors and/or variables are possible, providing the architect properly evaluates these adjustments. Figure 4 shows how all elementary schools were taken by project number from our data file for a three-year period and given an automatic update and an individual factor of standard location so that they became comparable on an equal basis. They were then given a high, medium and low average for all pertinent data. Under ordinary circumstances, the calculations required for this procedure might require several days of office time. With the aid of a computer, the task could be accomplished in minutes.

Let us now do a sample preliminary cost estimate. Figure 5 is a typical summary sheet which follows the format of the contractor's breakdown after completion of the job and is the construction portion of Figure 3 expanded as a format for the preliminary cost estimate as well as for the final cost file data.

Our office has found some significant ratios and numbers that allow us to compare any job with a new preliminary cost estimate or with other jobs. Now, by jumping right into a hypothetical situation, using Figure 4 as a data base and assuming

Figure 4

ALL ELEMENTARY SCHOOLS

ITEM	LOW	MEAN	HIGH	VARIANCE
RATIO	2.900	3.212	3.525	6.5 PCT
ENCLOSURE COST	$ 5.27/EU	$ 6.20/EU	$ 7.12/EU	10.0 PCT
BUILDING CSF	$16.92/SF	$19.87/SF	$22.82/SF	9.9 PCT
GEN CONST CSF	$11.37/SF	$13.40/SF	$15.43/SF	10.1 PCT
MECH/ELE CSF	$ 4.81/SF	$ 6.47/SF	$ 8.12/SF	17.0 PCT
GEN REQUIREMENTS	$ .10/SF	$ .63/SF	$ 1.15/SF	56.0 PCT
STRUCTURAL	$ 4.96/SF	$ 6.75/SF	$ 8.55/SF	17.7 PCT
ARCHITECTURAL	$ 3.08/SF	$ 4.75/SF	$ 6.42/SF	23.5 PCT
MISCELLANEOUS	$ .40/SF	$ 1.27/SF	$ 2.15/SF	45.7 PCT
PLUMBING	$ 1.18/SF	$ 1.79/SF	$ 2.40/SF	22.7 PCT
HVAC	$ 1.37/SF	$ 2.48/SF	$ 3.60/SF	29.8 PCT
ELECTRICAL	$ 1.56/SF	$ 2.19/SF	$ 2.83/SF	19.4 PCT
SITE WORK	5.1 PCT	12.2 PCT	19.3 PCT	38.9 PCT
GEN CONSTRUCTION	61.3 PCT	67.6 PCT	73.8 PCT	6.1 PCT
MECH/ELEC CONST	26.2 PCT	32.4 PCT	38.7 PCT	12.8 PCT
GEN REQUIREMENTS	.3 PCT	3.2 PCT	6.2 PCT	81.2 PCT
STRUCTURAL	26.2 PCT	34.0 PCT	41.9 PCT	15.3 PCT
ARCHITECTURAL	15.5 PCT	24.0 PCT	32.6 PCT	23.8 PCT
MISCELLANEOUS	2.3 PCT	6.2 PCT	10.2 PCT	41.8 PCT
PLUMBING	6.6 PCT	9.0 PCT	11.3 PCT	17.3 PCT
HVAC	6.8 PCT	12.5 PCT	18.1 PCT	30.1 PCT
ELECTRICAL	8.3 PCT	11.0 PCT	13.7 PCT	16.1 PCT
OTHER COSTS	.5 PCT	3.6 PCT	7.7 PCT	76.1 PCT

Figure 5

COST SUMMARY NO. 29
ARDEN ELEMENTARY SCHOOL - SAN BERNARDINO, CALIFORNIA
PROJECT NO. 1027 BID DATE - OCTOBER, 1968
FLOOR AREA - 36585 SQ. FT., ENCLOSURE AREA - 121219 E.U., RATIO - 3.313
TOTAL CONSTRUCTION COST - $816,766.00

A. SITE COSTS	$134,295.	---	16.4 PCT (OF TOTAL)	
B. BUILDING COSTS:	$673,883.	$18.42/SF	100.0 PCT	$5.56/EU
1. GENERAL REQUIREMENTS	$ 3,294.	$ .09/SF	.5 PCT	
2. STRUCTURAL	$176,838.	$ 4.83/SF	26.2 PCT	
3. ARCHITECTURAL	$208,707.	$ 5.70/SF	31.0 PCT	
4. MISCELLANEOUS	$ 66,092.	$ 1.81/SF	9.8 PCT	
5. PLUMBING	$ 49,278.	$ 1.35/SF	7.3 PCT	
6. HVAC	$ 95,194.	$ 2.60/SF	14.1 PCT	
7. ELECTRICAL	$ 74,480.	$ 2.04/SF	11.1 PCT	
C. OTHER COSTS	$ 8,588.	---	1.1 PCT (OF TOTAL)	
GENERAL CONSTRUCTION (1 - 4)	$454,931.	$12.43/SF	67.5 PCT	$3.75/EU
MECH.\ELEC. CONST. (5 - 7)	$218,952.	$ 5.99/SF	32.5 PCT	$1.81/EU

that Figure 5 is a new school job, let us first itemize some observations about this sample project. For instance, the floor area is of average size, neither small nor large. That factor could change the cost up to plus/minus 10 percent. It has no remodel portions that would have to be compared with other remodel jobs. It is of average breakup for a semiopen plan school which could vary the enclosure area and its ratio from 3.100 to 3.400. The enclosure ratio (ER) is the comparison of enclosure area or units (EU) with the floor area as a ratio: ER=EU/Floor Area.

These facts are assumed from Figure 4 averages and applied to the new cost estimate. So here we go toward a budget. First, the schematic floor plans give the square footage at 36,000. Assuming a 10-foot ceiling height, our takeoff with the linometer gives 120,000 for the enclosure area. We know that this type of school should have an ER of about 3.3; the ratio works out to 3.33. From Figure 4 we investigate the complexity (EU) of this school from schematic drawings compared with the mean and make a judgment that it is somewhat simpler than average: somewhere between the low of $16.92 and $19.87. At this stage, let us use $18/square foot, or $650,000, and $5.40 EU, or

Mr. Blurock, senior member in the Corona Del Mar, California, firm of William Blurock & Partners, is chairman of the AIA Computerized Practice Aids Task Force.

$650,000. These seem to check quite well. We also know, by comparison, that the site work involves a bad soil condition and is quite extensive; so without a proper survey and a detailed plot layout at the schematic stage, we revert to the percentage method of cost analysis and combine it to come up with a logical site cost. Again, from Figure 4, we see that site work varies from 5.1 percent to 19.3 percent. On this project we will use a high of 18.5 percent, or about $150,000; thus, our combined total construction budget is a nice round $800,000.

At the preliminary or design development stage the project cost is updated and reviewed. The square footage finalizes at 36,585 x $18, or $658,530. Reducing the site work by design from $150,000, we feel that it can be brought down to $140,000, making our total budget $798,530, or near our original $800,000.

In breaking down the construction cost further, we can see from Figure 4 that an average percentage of the cost due to electrical/mechanical elements is about 32.4 percent. This being by design an average project, we have $658,530 without site work; of that, $450,000 is in general construction (including structural) and $210,000 in electrical/mechanical. This is now broken down into 11 percent electrical; 12.5 percent heating/ventilation and airconditioning; and 9 percent plumbing—to be checked with the consultants. Figure 5 gives the final cost from the contractor's construction cost record, noting a 2 percent difference in budget to bid and like comparisons on the breakdown.

Figure 6 is a unique project because we started with a $2 million budget and by the time we had arrived at schematic drawings, we determined that the client could only afford about 70,000 square feet or 180,000 enclosure units, plus the required site work and elevators which were listed under other costs. This job

Figure 6

COST SUMMARY NO. 26
ALLERGAN PHARMACEUTICALS II HIGH RISE - IRVINE, CALIFORNIA
PROJECT NO. 1020, BID DATE - APRIL, 1970
FLOOR AREA - 69245 SQ. FT., ENCLOSURE AREA - 181640 EU, RATIO - 2.623
TOTAL CONSTRUCTION COST - $2,066,000.00

A. SITE COSTS	$ 188,000.	---	9.1 PCT OF TOTAL	
B. BUILDING COSTS	$1,829,000.	$26.41/SF	100.0 PCT	$10.00/EU
1. GENERAL REQUIREMENTS	119,400.	$ 1.72/SF	6.5 PCT	
2. STRUCTURAL	739,000.	$10.67/SF	40.4 PCT	
3. ARCHITECTURAL	533,000.	$ 7.70/SF	29.1 PCT	
4. MISCELLANEOUS	12,100.	$ .17/SF	.7 PCT	
5. PLUMBING	153,000.	$ 2.21/SF	8.4 PCT	
6. HVAC	155,000.	$ 2.24/SF	8.5 PCT	
7. ELECTRICAL	117,500.	$ 1.70/SF	6.4 PCT	
C. OTHER COSTS (ELEVATORS)	49,000.	---	2.4 PCT OF TOTAL	
GENERAL CONSTRUCTION	1,403,500.		76.7 PCT	$7.73/EU
MECH.\ELEC. CONST.	425,500.		23.3 PCT	$2.34/EU

progressed through working drawings to bidding, and with the acquisition of a new product line the company elected to add another floor (14,000 square feet plus/minus). It was simple, by analysis, to arrive at the cost for the added floor by projecting $26.40 per square foot ($10 per EU) with an added cost of $370,600 plus some $9,000 other costs for added parking, utilities and elevator extension, for a total of $2,434,600. Our contract to date stands at $2,445,000 as the building is now under construction.

Now we should stop and evaluate what we have done and where it can lead us. The first example gave an average and a manner in which to compare the estimate all three ways: from square footage method, to enclosure unit, to percentage method for crosschecking. The second job has many more ramifications. First, the unit of enclosure in an office loft building must be compared with like buildings of a multistory range (this one was five stories). In adding partitions, etc., it raised the EU with floor area changing. This indicates to the architect that t per unit will change, thus enabling him to show the own the complexity has increased not the size but the cost building. If the enclosure unit is used for nothing else l demonstration of this point, it is valid. We could also ta extra floor, its walls system, etc., and project much more rately with enclosure unit than with the square footage n

Another reason for using all three methods is that in about 11 percent of each job is electrical, while in a loft b it is much less—about 6 to 7 percent; in an industrial b this percentage can vary greatly, up to 20 percent. This las parison can be deceiving since the square foot and enclosu cost are low, and an increase in any one of the breakou will affect the overall picture. In an industrial building, the ture may be $6 per square foot and be 50 percent of th cost, where a gymnasium of the same square footage a closure units might be 20 percent with the same unit cost.

After using the enclosure area and the enclosure ratio ods for almost a year, I should like to tell you some go bad points about their use. A major advantage is that a "r complexity," determined at the beginning of takeoff, can b as a crosscheck while progressing through the project. portant example of its use would be to show the client t adding this cabinet or that wall the cost had risen beca ratio has risen. Diehl points out in his article that enclosu should be carried to the third decimal place for proper co son. It is also interesting (and dangerous) that the ratio c plexity can remain constant while the cost per square foo rise as much as 30 percent, as shown by the comparison of nasium with an industrial building, or an office building science or research oriented structure. However, if you check with the percentage method and square foot cost, yo again proved the value of comparison by the three metho

From the historical data, you will also find that th centage ratio of breakdown will not vary as much as the c square foot (CSF) or the enclosure unit cost (EUC) for ing, heating and airconditioning and electrical work in a complicated building; therefore this demonstrates anothe reason for crosscheck of all systems. Such elements seem t a constant ratio with the variation of the enclosure units, l in a direct ratio with the square foot method.

Architects are becoming aware that they are dealin increasingly sophisticated clients. The large corporations, agencies and developers are demanding cost control ar budgeting that cannot be approached verbally or casu must be reached early in the project stages with enough ac that realistic banking-financing-budgeting of the project profit, not loss, for the venture. A quantity survey is not ac until all parts are pinned down. By waiting the approxima weeks bid period, we know precisely what the cost is. while, a year of work has been jeopardized by not *acc* estimating in the early stages of the project.

In summary, preliminary cost estimating should co size, quality and complexity; these factors can be reasona flected by intelligent use of the three methods of estimating have been described here. Don't compare apples with o The system won't work by using the wrong data base. which have accumulated a good file of historical cost da good updating information can usually make good cost tions. This leads to my final conclusion that it is essential profession to find means of establishing an information-s system and a data bank of building costs.